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(54)   Multiple virtual router

(57)   A multiple virtual router is a subsystem that allows multiple network layer protocols (i.e. IP, IPX and Bridging protocols) to co-exist on the same physical port 14. It provides a common set of interfaces between the Media Layer and the protocol processes. Media events or changes in the protocol port (i.e. port deletion, media deregistration, media registration, media state change, media mtu change, connectionless routing metric change, etc.) may be broadcast to each protocol giving them an accurate view of the system.

A multiple virtual router is disclosed which includes a housing and multiple routing modules distributed therein. A separate table is associated with each protocol within each routing module. The multiple virtual router also includes a management module for configuring the routing modules. Communications between the management module and the routing modules occurs out of band from the user traffic. Further, the housing may have multiple ports each of which is logically coupleable to different routing modules.
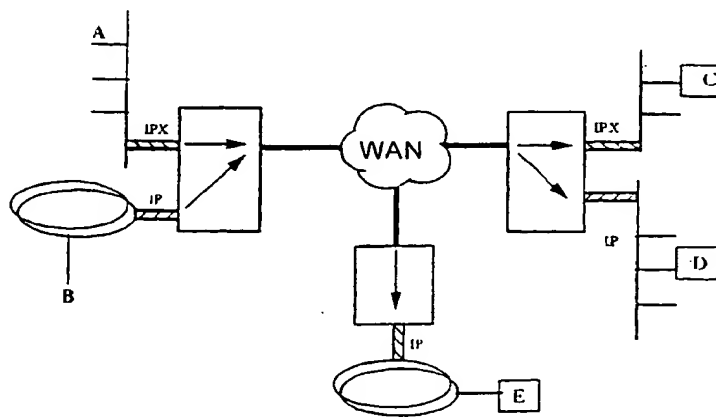
FIG. 3

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Description

[0001]   The invention relates generally to the field of routers and more particularly, to a single device having multiple independent router modules therein.

[0002]   With the growing popularity of the Internet and with the growing popularity of networks in general, there is a trend towards centralized network services and centralized network service providers. To be profitable, however, network service providers need to constantly maintain and if possible enlarge their customer base and their profits. However, leased line services are coming under increased competition causing profit margins to decrease for these providers. Thus, an increased number of providers are trying to attract small and medium sized businesses by providing centralized network management. Part of this network management should be that the service is provided from a centralized, secure network facility. There has been difficulty providing this service, however, due to address conflicts, security problems and costly upgrade requirements to customer premise equipment. Historical independent network development has resulted in conflicting and overlapping address space between the individual networks and the management networks.

[0003]   Others have attempted to solve these problems by using encapsulating techniques, such as internet protocol (IP) tunneling, to separate network traffic from unrelated networks. This method, however, suffers from many of the same problems. Inter-network security can not be guaranteed in IP tunneling as it relies upon customer premise equipment to be correctly configured. These encapsulating techniques also require upgrading the customer premise equipment to be compatible with the IP tunneling. Further, performance can be a problem since routing disturbances caused by one customer may affect the routing performance of another customer's network.

[0004]   Accordingly there exists the need for a centralized device which allows the implementation of separate networks over common infrastructure while providing security and performance to each network without the need to upgrade customer premise equipment.

[0005]   The need also exists for such a device which is smaller and cheaper than multiple separate routers yet easily managed.

[0006]   The need also exists for such a device which prevents unauthorized users on any of the networks from reconfiguring or otherwise managing the device.

[0007]   The need also exists for such a device having the ability to provide different quality of service to different networks.

[0008]   It is an object of the present invention to provide a device which substantially fulfills at least one of the above needs.

[0009]   This and other objects of the invention will become apparent to those skilled in the art from the following description thereof.

[0010]   It has now been discovered that the above and other objects may be accomplished by embodiments of the present multiple virtual router described herein. The invention includes a housing having at least one physical port. It also includes multiple routing modules disposed within the housing. A first of the routing modules has a first routing table associated therewith, while a second routing module has a second routing table associated therewith. The physical port may be logically connectable to both the first and the second routing modules.

[0011]   In one embodiment, the invention may include a management router module capable of selectively communicating with and configuring each of the routing modules. The management module may be capable of doing this communication and configuration out-of-band from normal user traffic.

[0012]   The invention will next be described in connection with certain illustrated embodiments; however, it should be clear to those skilled in the art that various modifications, additions and subtractions can be made without departing from the scope of the claims.

[0013]   For a fuller understanding of the nature and objects of the invention, reference should be made to the following detailed description and accompanying drawings, in which:

> FIG. 1 depicts a block diagram of the preferred embodiment of a multiple virtual router in accordance with the invention;
> FIG. 2 depicts the embodiment of FIG. 1 showing a management module connected to multiple routing modules;
> FIG. 3 depicts a possible configuration of multiple virtual routers in accordance with embodiments of the present invention, being utilized by multiple networks using different protocols.

[0014]   A multiple virtual router is a subsystem that allows multiple network layer protocols (i.e. IP, IPX and Bridging protocols) to co-exist on the same physical port 14. It provides a common set of interfaces between the Media Layer and the protocol processes. Media events or changes in the protocol port (i.e. port deletion, media deregistration, media registration, media state change, media mtu change, connectionless routing metric change, etc.) may be broadcast to each protocol giving them an accurate view of the system.

[0015]   A multiple virtual router is disclosed which includes a housing and multiple routing modules distributed therein. A separate table is associated with each protocol within each routing module. The multiple virtual router also includes a management module for configuring the routing modules. Communications between the management module and the routing modules occurs out of band from the user traffic. Further, the housing has multiple ports each of which is logically coupleable to different routing modules.

[0016] Multiple virtual routers maintain a set of logical network interfaces 16 mapped to the physical ports 14 (i.e. DS3 frame relay ports) that allow a protocol to forward packets between different media, such as local area networks (i.e. Fddi, Ethernet, and Token Ring) and wide area networks (i.e. FrDte, X25Dte, and Ppp). The logical ports (i.e. DLCI on the frame relay port) are distributed to each logical processor and updated by a forwarding agent. The forwarding agent is used to provide current information about the node and physical interfaces 14 to the routing modules 12 so that forwarding decisions can be readily made.

[0017] Each physical port 14 may contain information about the media and data used by the protocol to forward packets to that physical port 14. The media specific portion is sent by media applications when they register with the multiple virtual router. Similarly the protocol data is specified by the protocol when it registers with the multiple virtual router.

[0018] FIG. 1 is an illustration of an embodiment of the invention including various multi-protocol router modules 12 disposed within a common housing 10. Those skilled in the art will recognize that while FIG. 1 illustrates these routing modules 12 as being entirely disjoint, it is possible to connect some or all of them together without departing from the scope of the invention. The housing 10 has at least one physical port 14 which may be selectively, logically connected to various ones of the router modules 12 as represented by logical connections 16 (interfaces). While FIG. 1 illustrates only one physical port 14 and two routing modules 12, those skilled in the art will recognize that more than two routing modules 12 and/or more than one physical port 14 may be employed. Further, a particular physical port 14 may be selectively, logically connected/connectable to (i) one router module 12, (ii) multiple router modules 12, or (iii) all of the available router modules 12. With certain exceptions which will become evident from this disclosure, the routing modules 12 perform the same as conventional routers.

[0019] The routing modules 12 may be assigned different priorities for performing certain tasks. For example, assigning one routing module 12 a higher priority route calculation (i.e. the recalculation of forwarding information upon receiving routing update/changes from other nodes) and forwarding of data than another routing module 12 enables the higher priority routing module 12 to route traffic received on the links 16 to that routing module 12 at a higher priority than traffic on lower priority routing modules 12. In this way, a high priority client could be provided a high priority virtual router and a low priority client could be assigned a lower priority virtual router. In addition, routing table updates, and routing processing may be prioritized as well. This prioritization would give the service provider the opportunity to offer different services and charge different rates for different clients.

[0020] A multiple virtual router may also include a management router module 18 as illustrated in FIG. 2. The management router module 18 allows configuration and diagnostic access to the router modules 12 in a secure manner which may be out-of-band with normal user traffic as shown by connections 20. Connections 20 may be a bus, point to point connections or simply logical connections. The management router module 18 may enable a management network to access each individual router module 12 in a particular multiple virtual router without being connected to each individual router module 12 (i.e. without the need for a full mesh interconnection between the management network and each individual router module 12). Additionally, a management router module 18 could route management traffic to another multiple virtual router if necessary. In this way, a variety of multiple virtual routers could be managed using normal IP or IPX routing techniques.

[0021] In today's IP and IPX networks, management of routers occurs in-band with user traffic. Thus great efforts must be expended to protect the management interface from illegitimate access by users of the network. Another concern is that the managing authority could be denied access to the router and a customer could be denied service. By providing a completely separate management network (including a management router module 18) as embodiments of the present invention can, the management authority can effectively configure and control the router network in a secure and consistent fashion without these typical security and accessability concerns. One skilled in the art will recognize that it is possible to use conventional in-band management techniques with the present invention, however, then the management authority would still need to be concerned with the present security and accessability issues.

[0022] FIG. 3 illustrates a possible configuration of multiple virtual routers in operation. The virtual routers allow each protocol (i.e. IP and IPX) to share the same physical link. This gives each protocol access to a private virtual network. In the configuration illustrated in FIG. 3, network C is visible to network A through IPX's routing tables, just as networks D and E are visible to network B through IP's routing tables. To each protocol it appears as though it is the only protocol running on the network. The virtual routers isolate the protocols, but maintain connectivity to the media (i.e. the WAN) so that events are broadcast and status information is kept current. Those skilled in the art will realize that each router module 12 may be a multi-protocol router capable of running multiple protocols concurrently. Since it is common for one network to be running many protocols simultaneously, the multiple virtual routers may provide isolation (i.e. independent address space and independent network routing updates for each network) between different clients running the same or different routing protocols.

[0023] It will thus be seen that the invention efficiently attains the objects set forth above, among those made

apparent from the preceding description. In particular, the invention provides multiple virtual routers. Those skilled in the art will appreciate that the configurations depicted in FIGS. 1, 2 and 3 disclose centralized devices which allow the implementation of separate networks over common infrastructure while providing security and performance to each network without the need to upgrade customer premise equipment.

[0024] It will be understood that changes may be made in the above construction and in the foregoing sequences of operation without departing from the scope of the invention. It is accordingly intended that all matter contained in the above description or shown in the accompanying drawings be interpreted as illustrative rather than in a limiting sense.

Claims

1. A multiple virtual router comprising:

    a port;
    a plurality of routing modules;
    a first table associated with a first of said plurality of routing modules;
    a second table associated with a second of said plurality of routing modules;
    wherein said port is logically coupleable to different ones of said plurality of routing modules.

2. A multiple virtual router as claimed in Claim 1 further comprising:

    a management routing module connectable to each of said plurality of routing modules and capable of selectively communicating with and configuring each of said plurality of routing modules.

3. A multiple virtual router as claimed in Claim 2 wherein communications between said management routing module and at least one of said plurality of routing modules takes place out-of-band from normal user traffic through said at least one of said plurality of routing modules.

4. A multiple virtual router as claimed in claim 2 or claim 3 wherein said management routing module is configured to have a higher priority for communicating than said plurality of routing module.

5. A multiple virtual router as claimed in any of the above claims wherein said first of said plurality of routing modules is assigned a higher priority for routing data than said second of said plurality of routing modules.

6. A multiple virtual router as claimed in any of the above claims wherein said first table is updated on a higher priority basis than said second table.

7. A multiple virtual router as claimed in any of the above claims wherein said first of said plurality of routing modules is configured to forward traffic at a higher priority than said second of said plurality of routing modules.

8. A multiple virtual router as claimed in any of the above claims comprising a plurality of ports and wherein each of said plurality of ports is logically connectable to each of said plurality of routing modules.

9. A multiple virtual router as claimed in any of claims 2 to 4, or any of claims 5 to 8 when dependent upon claim 2, wherein said management module is capable of configuring at least two of said plurality of routing modules for use by different networks.

10. A multiple virtual router as claimed in claim 9 comprising a plurality of ports; wherein at least one of said plurality of ports is logically coupled to each of said plurality of routing modules; and said management module is coupled to said at least one of said plurality of ports.

11. A multiple virtual router for routing communications between at least two networks employing a common protocol, and having the ability to simultaneously route communications between at least two other networks employing the same or a different common protocol, said multiple virtual router comprising:

    a plurality of routing means for routing communications between said at least two networks employing a common protocol; and,
    a plurality of interface means arranged to connect at least one of said routing means to said at least two networks.

12. A multiple virtual router as claimed in claim 11 further comprising:

    management means for configuring said plurality of routing means;
    wherein said management means is logically coupled to said plurality of routing means.

13. A multiple virtual router as claimed in claim 12 wherein said management means is selectively configured to have a higher priority for communicating than said plurality of routing means.
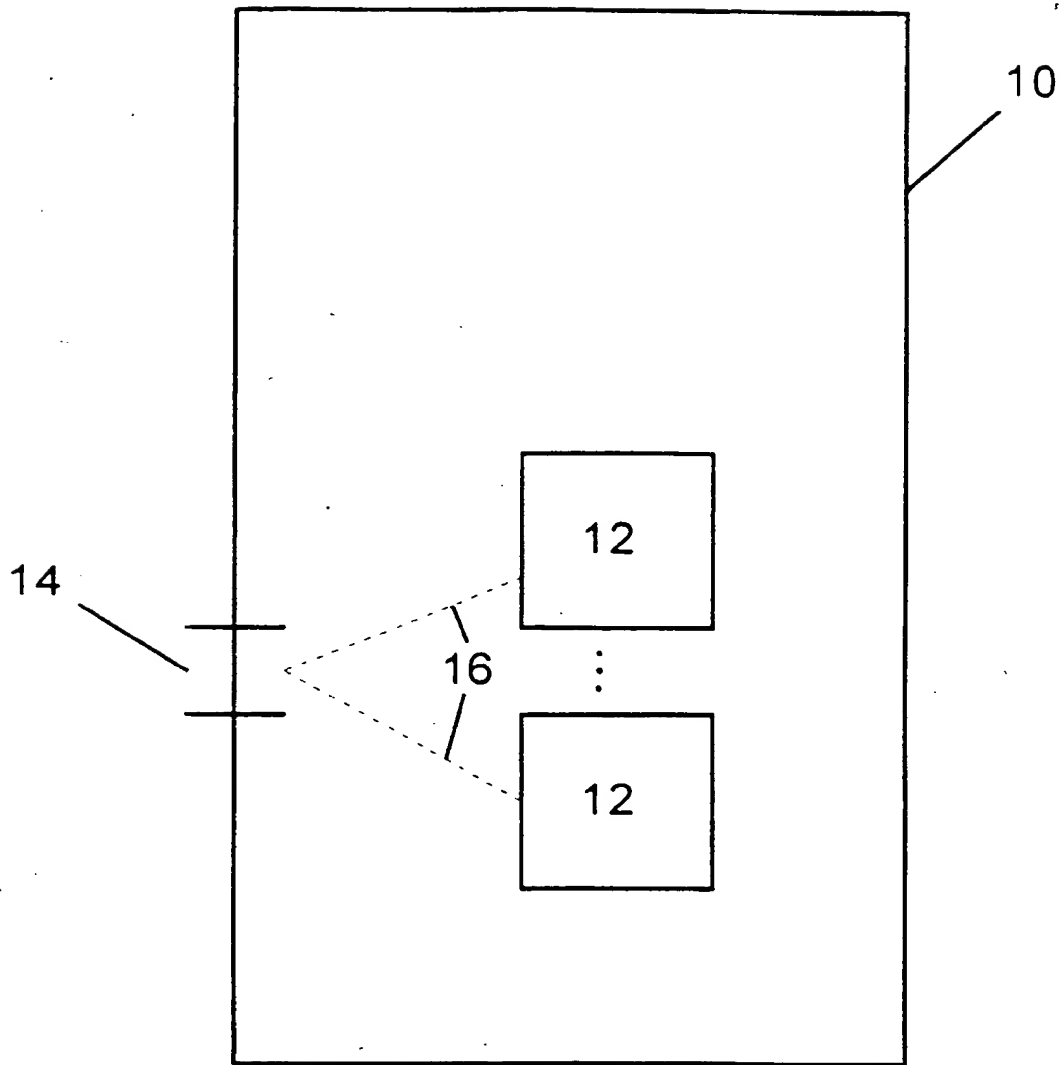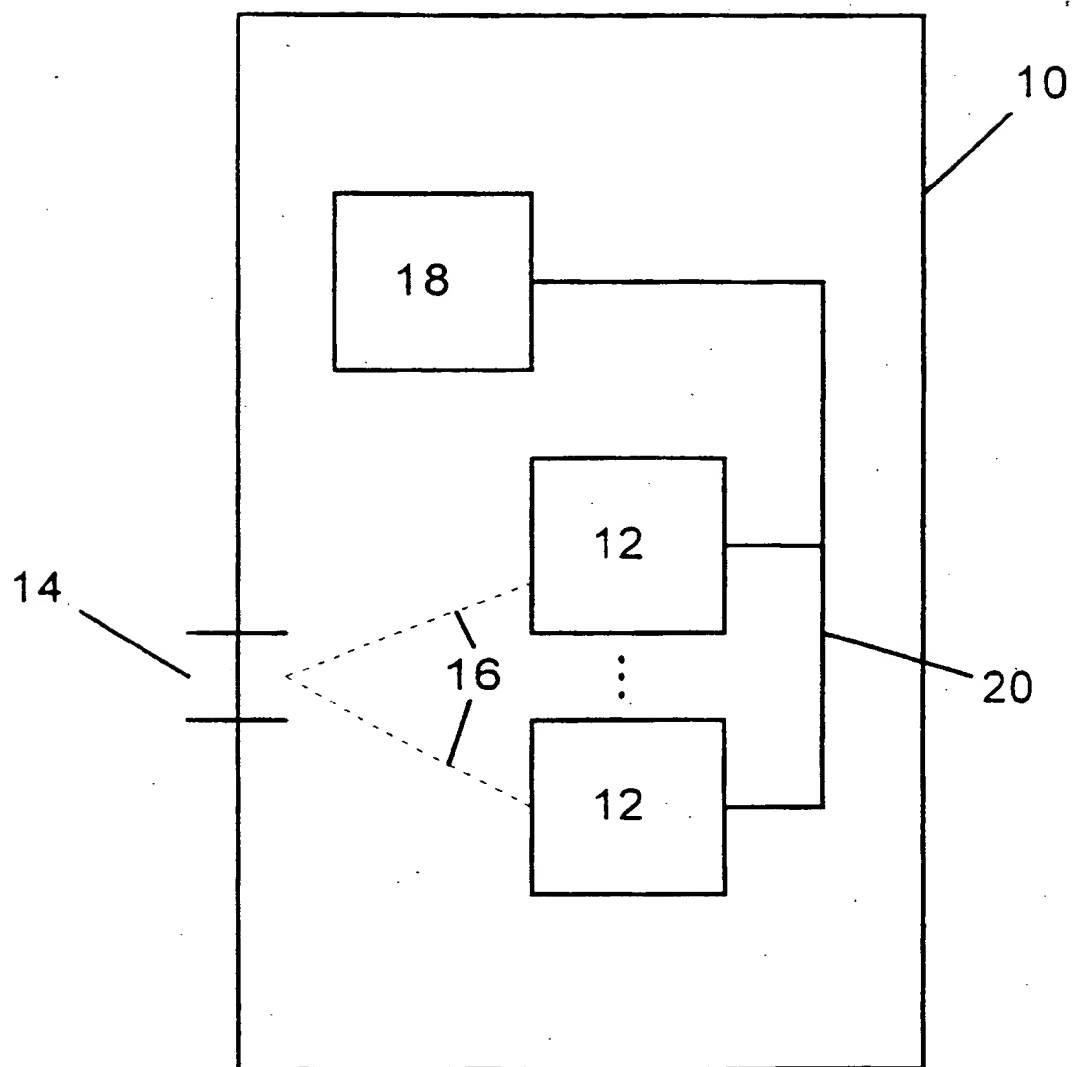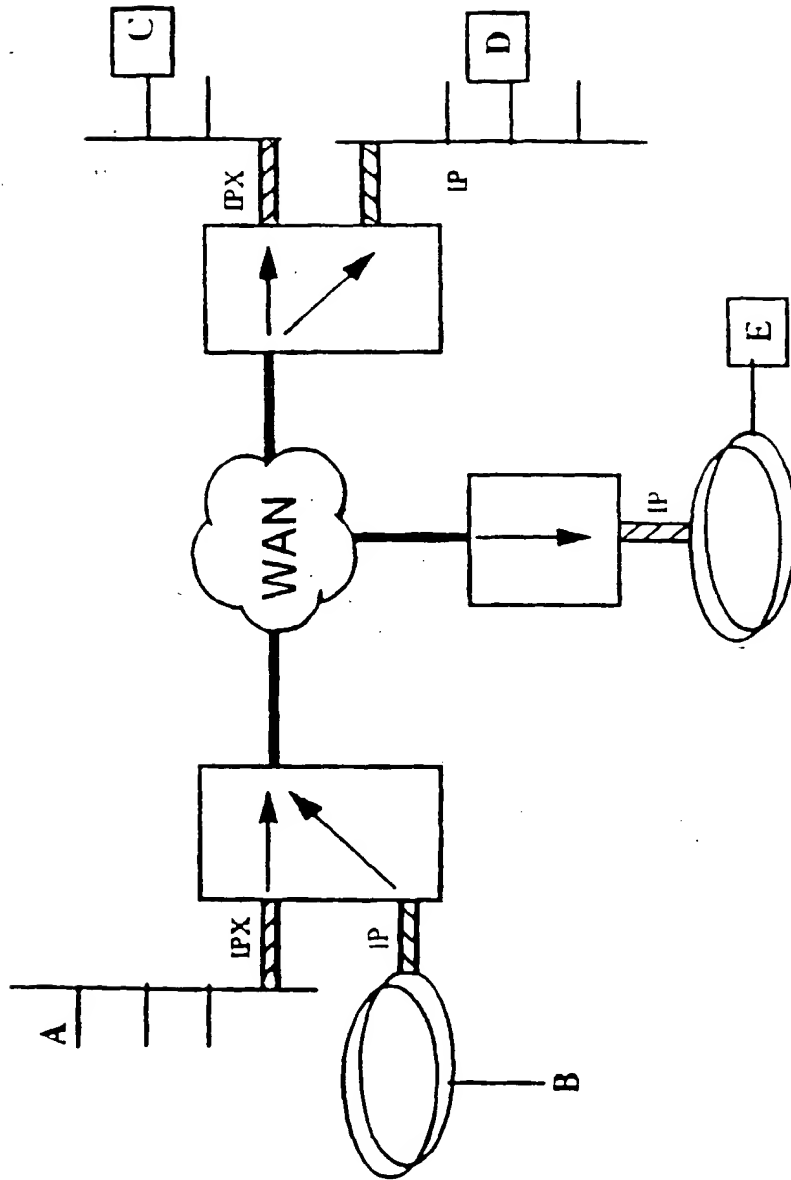
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14

12

16

12

FIG.1

FIG. 2

FIG. 3

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FIG. 3

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EUROPEAN SEARCH REPORT

Application Number

EP 98 31 0504

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 5 550 816 A (HARDWICK KEN ET AL) 27 August 1996 (1996-08-27)	1,2,8-12	H04L12/46 H04L12/56
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	12 June 2002	Losseau, D

EPO FORM 1503 03.82 (P04C01)

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European Patent Office

EUROPEAN SEARCH REPORT

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	12 June 2002	Losseau, D

CATEGORY OF CITED DOCUMENTS

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    document

3

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ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.   EP 98 31 0504

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The members are as contained in the European Patent Office EDP file on
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